

Interactive comment on “Longer spring snowmelt: spatial and temporal variations of snowmelt trends detected by passive microwave from 1988 to 2010 in the Yukon River Basin” by K. A. Semmens and J. M. Ramage

Anonymous Referee #1

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General Comments

This study utilizes satellite passive microwave measurements to determine snow melt onset timing and duration across the Yukon River basin. Time series of these melt parameters are correlated with climate (solar flux; ENSO) and physiographic (latitude; elevation) variables in order to determine the primary influences on melt variability and trends.

The paper is clearly organized and well written. The melt retrieval algorithm is de-

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scribed and validated in previous studies. While the work is novel, strong physical evidence is not provided for the statistical conclusions, likely due in part to the relatively short time series and small spatial domain. While the study is of interest to the remote sensing and northern hydrology communities, the lack of conclusive statements on the physical controls on melt timing limit the impact of this paper.

I hope the following comments constructively improve the manuscript.

1. Statements on the physical mechanisms or the variables controlling the melt trends/variability are inconclusive and speculative.

Examples include: Page 716 line 13: “Moving interval trends suggest interannual variability within the time series. . .” Page 716 line 14: “. . .possibly related to El Nino- Southern Oscillation. . .” Page 724 line 17: “These alternations suggest a sub-trend cyclic pattern such as ENSO.” Page 724 line 23: “(possibly related to ENSO)” Page 725 line 4: “. . .possibly related to ENSO and the solar cycle. . .”

Related to this, the primary conclusions lack a clear mechanism to explain the statistical findings, with the interpretations remaining speculative. For example, page 726 lines 11-14: “The prevalence of snow in high elevations have a buffering effect on changes while lower elevation snow variability may suggest climate change susceptibility, both factors that can influence the timing trends presented here.” In the absence of any snow measurements (which should be available for some locations) this is a purely speculative statement.

2. Multiple regression results are described on page 715 lines 8-11, and are reported as % variance explained (R^2). This is followed by correlation results, which presumably are reported as r values (but this is not stated explicitly). There is a lack of clarity how the regression and correlation analysis were setup. While the reported correlations are significant, they are only moderate in strength (maximum r value of 0.44). I suspect the moderate statistical results are the cause of the numerous speculative statements throughout the paper (see previous comment).

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3. The DAV melt retrieval technique is mature, well validated, and fully described in the literature. The nature of the algorithm however, means that only melt onset and end of melt/refreeze can be retrieved. Melt onset is a direct and useful retrieval, but the interpretation of the end of melt/refreeze variable is more problematic to me. This identifies a specific transition period in the melt process, but this is an ambiguous parameter not necessarily related to snow clearance date. The use of this variable requires justification, and an explanation of the climatological or hydrological significance.

4. The statement on page 717 lines 13-16 is problematic to me: "...with early melt, the snowmelt period may be longer, snow gradually depleted, and runoff spread out, but with late melt, the snowmelt is rapid, synchronous, and peak runoff high." It's not clear to me why early snow melt would occur over a longer period and the snowpack is gradually depleted and vice versa for late melt onset. The rate of snow melt is controlled by the intensity of the melt— early melt can still be short if temperature departures remain strongly positive.

5. It is difficult to envision how the peak periods for melt onset (Fig 2b) could differ so differently from the end of melt/refreeze (Fig 2c). The time lag between melt onset and end of melt/refreeze must only be a couple of weeks at most, and both variables are driven by temperature. But ENSO is a low-frequency phenomenon, so conceptually I find it difficult to meaningfully interpret how ENSO could influence those variables differently.

Editorial Comments

Page 719 line 2: what is meant by 'diminished snow cover'? This is a vague term that can be interpreted as lower snow depth or earlier snow melt.

Lines 123/124: "...a measure of the dynamism of the snowpack..." This might be a little picky, but the DAV is actually a measure of the dynamism of the brightness temperature, which can be interpreted as a proxy of the dynamic response of the snowpack emissivity to changing liquid water content.

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Interactive comment on The Cryosphere Discuss., 6, 715, 2012.

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